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MICROBIAL COMMUNITY STRUCTURE AND LITTER DECOMPOSITION IN STRATIFIED SOILS OF A LONG TERM REDUCED TILLAGE EXPERIMENT

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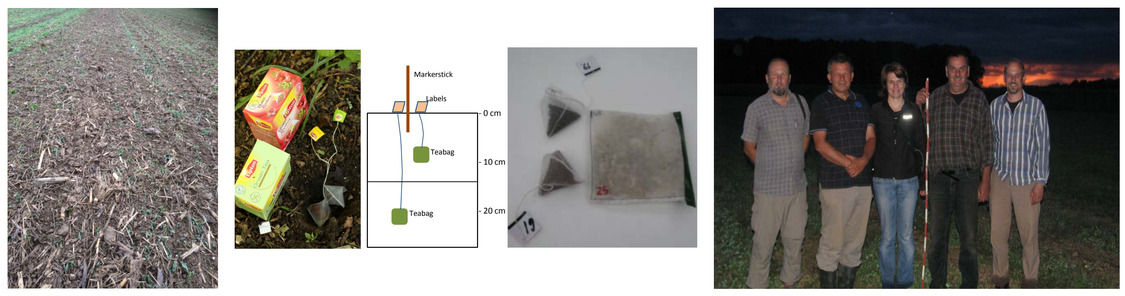
Introduction

The aim of the present study was to examine decomposition of plant material (**maize straw, green and rooibos tea**) in stratified soils of the long-term tillage experiment, established in 1999 and shifted from conventional **to organic farming system** in 2015.

The plowing in conventional tillage (CT) has been done by moldboard plow 20 cm deep, while in minimum tillage (MT), soil disturbance has been up to 10 cm deep by a special disc harrow. More than 15 years of long term minimum tillage, with reduced soil disturbances and improved residue management, resulted in stratification of soil organic carbon and nutrients with highest concentrations in the very topsoil.

Soil organic carbon content under MT 0-10 was significantly higher in comparison to CT 0-10 (1.60±0.07 % and 1.45±0.05 %, respectively), as well as in the 10-20 cm layers of MT and CT (1.33 ±0.05 % and 1.40±0.04 %, respectively). Also several other soil properties, such as soil structure and water retention characteristics, were improved in the topsoil of MT in comparison to CT (Kaurin et al., 2015). Litter decomposition was followed during two winter seasons 2015/16 and 2016/17.

Methods



Rooibos and Green tea bags, and *litter* bags filled with maize straw from the site were incorporated in Nov. 2015 and sampled after 21, 91, 109, 140 days (16.12.2015 / 24.02.2016 / 13.03.2016 / 13.04.2016). Additional tea bags were incorporated in November 2016 and sampled after 111 days (14.03.2017).

Microbial biomass was measured by fumigation-extraction method (DIN ISO 14240-2:1999-10). The abundances of the total bacterial and crenarchaeal 16S rRNA (Ochsenreiter et al., 2003), and fungal ITS genes (White et al., 1990) were assessed by using qPCR.

Results

Microbial biomass and abundance

Season 2015/2016

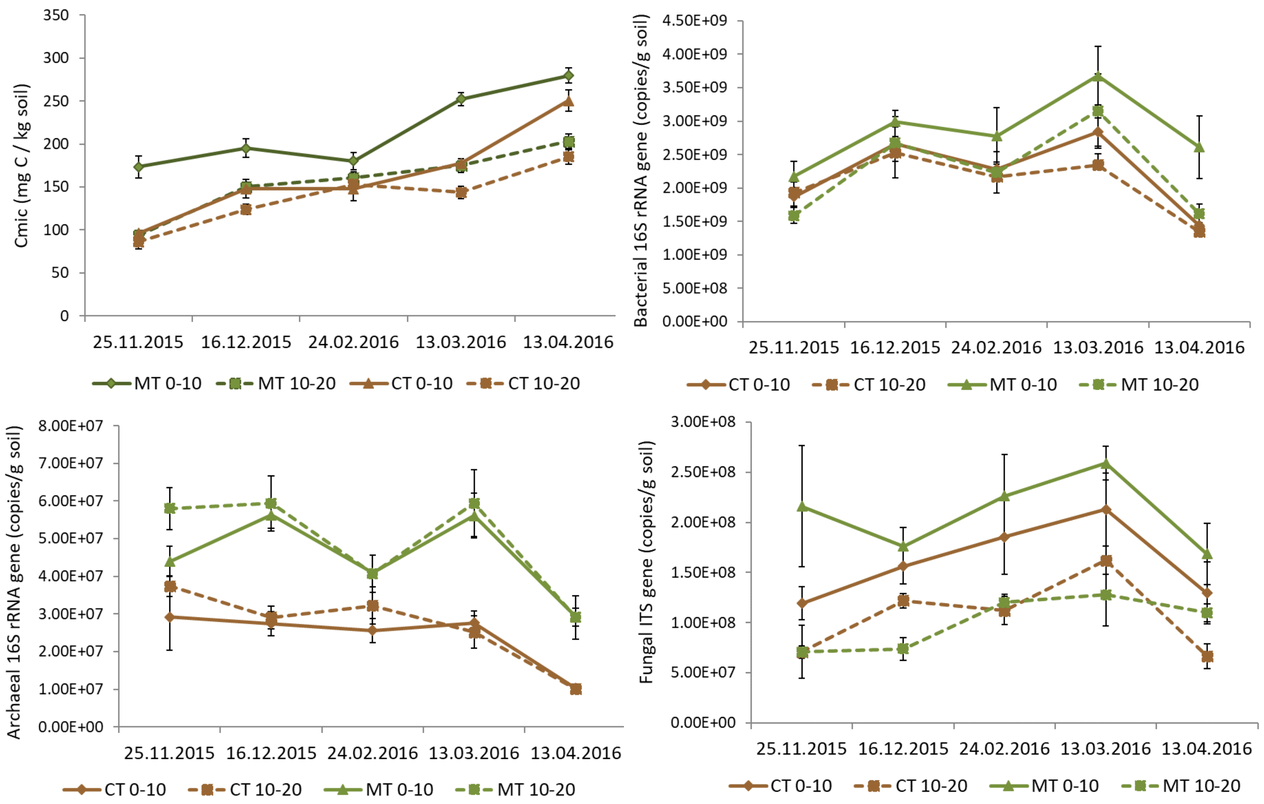


Fig. 1: Microbial carbon (Cmic), bacterial, crenarchaeal and fungal copy numbers under minimum (MT) and conventional tillage (CT) at two soil layers during the season 2015/2016.

Litter decomposition

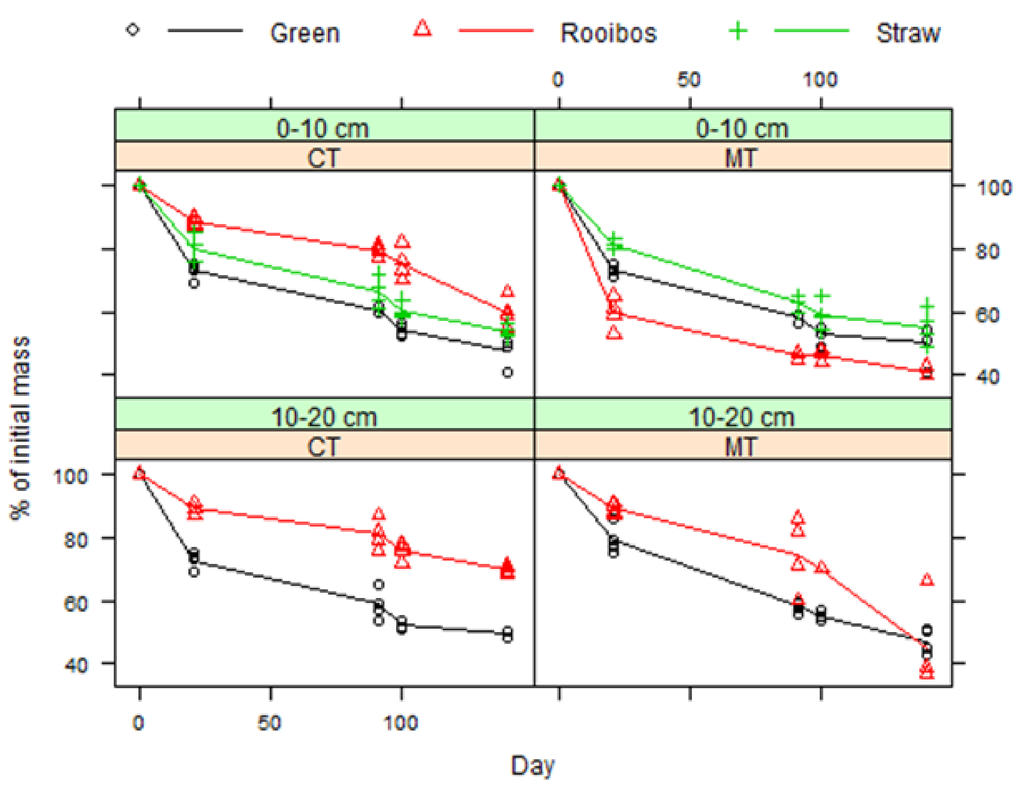


Fig. 2: Decomposition of green tea, rooibos tea and maize straw under minimum (MT) and conventional tillage (CT) at two soil layers during the season 2015/2016.

Season 2016/2017

Table 1: Temporal variation of bacterial, crenarchaeal and fungal copy numbers under two tillage treatments (MT, CT) and two teas (green – G, rooibos - R) during the season 2016-2017.

Treatment	Date	Bacterial 16S rRNA (copies/g)	Archaeal 16S rRNA (copies/g)	Fungal ITS (copies/g)
MT 0-10	22.11.2016	1.68E+09 ± 1.52E+08	1.71E+06 ± 6.81E+04	2.62E+08 ± 3.52E+07
CT 0-10		9.06E+08 ± 6.14E+07	6.50E+05 ± 4.58E+04	1.54E+08 ± 4.02E+07
MT 0-10 G	14.03.2017	1.90E+09 ± 1.57E+08	2.36E+06 ± 2.36E+05	3.75E+08 ± 9.08E+07
MT 0-10 R		1.96E+09 ± 1.01E+08	1.99E+06 ± 1.14E+05	2.93E+08 ± 4.44E+07
CT 0-10 G		1.51E+09 ± 1.73E+08	1.31E+06 ± 1.27E+05	1.81E+08 ± 2.94E+07
CT 0-10 R		1.67E+09 ± 1.33E+08	1.39E+06 ± 1.49E+05	2.94E+08 ± 1.15E+08

Table 2: Decomposition of green tea (G) and rooibos tea (R) and temporal variation of microbial carbon and nitrogen (Cmic, Nmic) under minimum (MT) and conventional tillage (CT) at 0-10 cm depth during the season 2016/2017.

Treatment	Date	of initial ma	Cmic (mg/kg)	Nmic (mg/kg)
MT 0-10	22.11.2016	100	397 ± 32	51,3 ± 5,1
CT 0-10		100	270 ± 41	37,9 ± 6,7
MT 0-10 G	14.03.2017	52,6 ± 1,7	431 ± 34	71,9 ± 5,0
MT 0-10 R		77,2 ± 0,4	458 ± 36	67,2 ± 6,4
CT 0-10 G		52,3 ± 0,4	256 ± 13	37,8 ± 2,3
CT 0-10 R		78,5 ± 0,3	252 ± 15	38,0 ± 0,7

Conclusion

- ❑ Microbial biomass (Cmic and Nmic) responded to higher organic matter contents under MT 0-10 in both seasons (Fig. 1, Tab. 2).
- ❑ The most pronounced differences between treatments were found in crenarchaeal abundance with significantly higher gene copies in the 0-10 cm layer of MT than of CT. Bacterial abundance was also higher in the topsoil of MT than CT in both seasons, while tillage had no significant influence on fungal abundance.
- ❑ Tillage had no significant effect on litter degradation during examined seasons.
- ❑ In general, higher degradation rate was observed for green than rooibos tea. Interestingly, rooibos tea decomposition seemed to be accelerated under MT 0-10 in 2015/2016. However, not in the season 2016/17.
- ❑ Green tea and maize straw from the field showed similar degradation rates and dynamic under our experimental conditions.

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